

VPDES PERMIT FACT SHEET

This document gives pertinent information concerning the reissuance of the VPDES permit listed below. This permit is being processed as a *Minor, Municipal permit*. The effluent limitations contained in this permit will maintain the Water Quality Standards of 9VAC25-260 et. seq. The discharge results from the operation of a 0.030-MGD activated sludge/extended aeration sewage treatment plant consisting of a bar screen, oxidation ditch, secondary clarifier, chlorinator/contact tank, dechlorinator, cascade post aerator, aerated sludge holding tank, and sand drying beds. This permit action consists of limiting pH, biochemical oxygen demand, total suspended solids, dissolved oxygen and total residual chlorine in an *Unnamed Tributary to Bad Branch of Guest River* and requiring other special conditions, monitoring and reporting requirements. The SIC Code for this facility is 4952.

1. Facility Name and Applicant Address:

Wise Correctional Unit 18 STP - Virginia Department of Corrections
Environmental Services Unit - Western Service Area
Marion Correctional Treatment Center
110 Wright Street
Marion, Virginia 24345

Facility Address/Location:

Wise Correctional Unit 18 STP
PO Box 1198
Coeburn, Virginia 24230

Location: State Route 72, 1.5 miles South of Coeburn, VA

2. Permit No. VA0023477 Existing Permit Expiration Date: 06/30/2012

3. Owner/Permit Contact:

Name: Randall M. Hubble
Title: Environmental Services Manager
Telephone No: 276-783-7154
Fax No: 276-783-8720
Mobile: 276-780-2152
Email: Randy.hubble@vadoc.virginia.gov

Facility Contact:

Name: James E. Stidham
Title: Operator
Telephone No: 276-679-9204
Mobile: 276-571-1750
Email: James.stidham@vadoc.virginia.gov

4. Application Complete Date: January 31, 2012

Permit Drafted By: Steve E. Artrip
Southwest Regional Office

Steve E. Artrip

Date: 2/8/2012

Reviewed By: Fred M. Wyatt
Southwest Regional Office

Fred M. Wyatt

Date: 2/8/2012

Public Comment Period Dates: from _____ to _____

5. Receiving Stream Name: Unnamed Tributary to Bad Branch of Guest River
River Mile: 6AXD0000.26
Basin: Tennessee-Big Sandy River
Subbasin: Clinch River
Section: 2
Class: IV
Special Standards: None

The receiving stream (*Unnamed Tributary to Bad Branch of Guest River*) is depicted as a dry ravine on the USGS Coeburn Quadrangle topographic map. Therefore, the flow frequencies for dry ravines are 0.0 cfs for the 1Q10, 7Q10, 30Q5, high flow 1Q10, high flow 7Q10 and harmonic mean and are not considered perennial state waters. The Office of Water Quality Assessments also calculated drought flow frequencies at Bad Branch above unnamed tributary. This is the point at which water quality criteria will apply and considered perennial state waters. See Attachment No. 1 for a copy of the flow frequency determination for this outfall:

Q_{s-1}	= 1Q10 Flow	= 0.009	MGD
Q_{s-1}	= 1Q10 High Flow	= 0.036	MGD
Q_{s-7}	= 7Q10 Flow	= 0.010	MGD
Q_{s-7}	= 7Q10 High Flow	= 0.041	MGD
Q_{s-5}	= 30Q5 Flow	= 0.020	MGD
Summer-Dry Season (June-November)			
Winter-Wet Season (December-May)			

Tidal: No On 303(d) list? Yes (Tributary enters an approved TMDL Segment)

6. Operator License Requirements: None.
7. Reliability Class: - A Class III Reliability has been established for this facility and will be maintained in this permit.
8. Permit Characterization:
() Private () Federal (X) State () POTW () PVOTW

() Possible Interstate Effect () Interim Limits in Other Document
9. Provide a brief description of the wastewater treatment system.

OUTFALL NUMBER	DISCHARGE SOURCE (1)	TREATMENT (2)	FLOW (3)
001	Wise Correctional Unit # 18; Correctional Facility serving a population of 135.	The sewage treatment works consists of a 0.030-MGD activated sludge/extended aeration sewage treatment plant consisting of a bar screen, oxidation ditch, secondary clarifier, chlorinator/contact tank, dechlorinator, cascade post aerator, aerated sludge holding tank, and sand drying beds.	The design flow of the sewage treatment works is 0.030 MGD.

10. Sewage Sludge Use or Disposal:

A licensed septic tank pumper/hauler will be used to remove sludge from the treatment works as necessary and transport the sludge in a truck-mounted watertight to one of the three facilities listed below. These facilities will provide additional treatment and stabilization of the sludge prior to final disposal.

Town of Richlands WWTP (VPDES Permit No VA0021199)

Town of St. Paul STP (VPDES Permit No VA0026221)

Coeburn-Norton-Wise WWTP (VPDES Permit No VA0077828)

A Special Condition is contained in this permit, which will allow modification of the permit should the sludge management practices at this facility change. All changes must be submitted for review and approval 90 days prior to the effective date of the changes.

11. Discharge Location Description:

Name: Coeburn, VA Quadrangle

Map Number: 59-B

See Attachment No. 2 for a location map of the outfall.

12. Material Storage:

None reported.

13. Ambient Water Quality Information:

In response to Section 303(d) of the CWA, the VADEQ listed 28.33 miles of the Guest River (VAS-P11R) on Virginia's 1998 Section 303(d) list as being unable to attain the general standard for aquatic life and primary contact uses. The failure to attain the general standard for aquatic life use was determined through biological assessments of the benthic community. As a result a Total Maximum Daily load for aquatic life use impairment was prepared by DEQ and approved by EPA on 11/13/2003 and by the SWCB on 06/27/2007. There is no actual monitoring data from the receiving stream, Bad Branch but the discharge from the Wise Correction Unit 18 STP is within the watershed and listed in the Guest River TMDL.

14. Antidegradation Review & Comments:

Tier I (X)

Tier II _____

Tier III _____

The State Water Control Board's Water Quality Standards includes an antidegradation policy (9VAC25-260-30). All state surface waters are provided one of three levels of antidegradation protection. For Tier 1 or existing use protection, existing uses of the water body and the water quality to protect these uses must be maintained.

Tier 2 water bodies have water quality that is better than the water quality standards. Significant lowering of the water quality of Tier 2 waters is not allowed without an evaluation of the economic and social impacts. Tier 3 water bodies are exceptional waters and are so designated by regulatory amendment. The antidegradation policy prohibits new or expanded discharges into exceptional waters.

Based on the information provided in Item 13 above and considering that the original effluent limitations were based on the existing water quality standards, the receiving stream, *Unnamed Tributary to Bad Branch/Bad Branch* is considered to be a *Tier I stream*.

15. Site Inspection: Date: 11/08/2010

Technical Inspection Performed by: Wade Carico, Environmental Inspector, DEQ-SWRO. No problems were observed with the treatment works during the inspection and all units were functioning properly. Discharge Monitoring data from October 2007 thru January 2012 indicate excellent effluent quality.

16. Effluent Screening & Limitation Development:

a. Ammonia Nitrogen:

Effective on August 27, 2003 the State Water Control Board adopted new criteria for ammonia nitrogen (9 VAC 25-260-155). Generally, these newly adopted criteria are less restrictive than the previous ammonia criteria.

An acute ammonia nitrogen standard is now calculated without consideration of the stream temperature. The acute criteria are more restrictive if the trout species are present (*only Class V or VI waters*). The 1Q10 flow frequency value is used to calculate the steady state waste load allocations. A chronic ammonia nitrogen standard is now calculated by considering whether or not the early life stage of fish are present or absent and the pH and temperature of the stream. The 30Q10 flow frequency is also now used to calculate the steady state waste load allocations.

During permit reissuance in January, 1997, permit limitations for ammonia nitrogen were evaluated. The evaluation concluded that an ammonia nitrogen limitation was not necessary to protect water quality in Bad Branch of Guest River. Since the new water quality criteria for ammonia nitrogen are less restrictive than those used during the previous evaluation a new evaluation is not necessary. See Attachment 3 for a copy of the previous evaluation conducted in year 1997.

b. *BOD₅ - Biochemical Oxygen Demand*

In January 1997 the wasteload allocation model for BOD₅ was updated using new drought flow frequencies provided by WQAP in Memorandum dated December 13, 1996. See Attachment No. 4 for results of the model. A Dissolved Oxygen minimum limit of 6.1 mg/l and secondary limits for BOD₅ (30 mg/l monthly average and 45 mg/l weekly average) will be retained in the reissuance permit.

c. *Total Residual Chlorine/E.coli Bacterial Standards:*

In order to bring chlorine into consistency with the standards for all other toxic materials, the old standard was revoked and chlorine was included in 9VAC24-260-140.B., which became effective on 12/10/97. Chlorine limitations were established during the 2002 permit renewal and will be retained in the reissued permit. See Attachment No. 5 (2002 Chlorine Analysis).

On January 15, 2003, new bacteria standards in the Water Quality Standards Section 9VAC25-260-170.A became effective, as did the revised disinfection policy of 9VAC25-260-170.B. These standards replaced the existing fecal coliform standard and disinfection policy of 9VAC25-160-170. In short, E.coli criteria replaced the existing fecal coliform criteria for freshwater.

In accordance with the agency guidance for the new criteria, permittees, which use chlorine, may perform a study to demonstrate that chlorine limits can be used as a surrogate for bacteria limits in a permit for an individual discharge. Twelve (12) data points are considered as the minimum acceptable data set. Demonstration that chlorine is an adequate surrogate is considered satisfied if there are no exceedences of the applicable criterion in the demonstration data set while the discharge is in compliance with the permitted chlorine limits at the facility.

DEQ has reviewed E.coli/total residual chlorine data collected from several treatment works that employ different treatment technologies. The results of these studies indicate that chlorine is an adequate surrogate for the new E. coli criteria and the facilities are meeting the standard (126 N/100 ml geometric mean) under a normal range of total residual chlorine values. Therefore, only total residual chlorine monitoring is being required in the reissuance permit and it is not necessary for this facility to undertake the surrogate study.

d. pH:

pH concentrations are 6.0 S.U. minimum and 9.0 S.U. maximum in accordance with the criteria provided in the Water Quality Standards 9VAC25-260, et seq.

e. Total Suspended Solids:

Total Suspended Solids concentrations are 30 mg/l monthly average and 45 mg/l weekly average in accordance with the Federal Effluent Guidelines.

f. Reduced Monitoring:

EPA published "Interim Guidance For Performance-Based Reduction of NPDES Permit Frequencies" (EPA 833-B-96-001) in April 1996. Due to the exemplary operations of this sewage treatment works the facility continues to qualify for reduced monitoring. No violations of VPDES parameter data were reported for pH, Dissolved Oxygen, BOD₅, and TSS from October 2007 through the January 2012. Since pH is not directly adjusted by chemical addition the reduced monitoring frequency from 1/Day to 1/Week is being continued. Dissolved Oxygen minimum requirements are achieved by a passive cascade aerator; therefore the reduced monitoring frequency from 1/Day to 1/Week is being continued. Chlorine does not qualify for reduced monitoring because of the critical requirements for disinfection of wastewater. Reduced monitoring frequencies for BOD₅, and TSS from 1/Month to 1/3 are being continued.

PARAMETER	51 Month AVERAGE	Performance to Limit Ratio Percentage
BOD ₅	<5.0 mg/l	14%
TSS	<4.0 mg/l	11%
pH (Range)	6.4 - 8.1 S.U.	
Dissolved Oxygen	6.8 -8.6 mg/l	

The reduced monitoring frequencies were arrived at by calculating the 51 month composite average of the respective monitoring data and dividing it by the permit limit to determine the ratio of actual performance to the permit limit. The range of the pH values were within permit limits and Dissolved Oxygen minimum concentrations were within permit limits. A summary of the monitoring frequencies are listed below:

Provisions are contained in the permit to reinstate the more stringent monitoring frequencies should the facility be issued a Notice of Violation for any of the parameters listed below.

PARAMETER	NORMAL FREQUENCY	REDUCED FREQUENCY
BOD ₅	1/Month	1/3 Months
TSS	1/Month	1/3 Months
pH	1/Day	1/Week
DO	1/Day	1/Week

g. Basis for Effluent Limitations:

PARAMETER	(a) BASIS FOR LIMITS	DISCHARGE LIMITS (b) Final Limitations Effective From: July 01, 2012 - To June 30, 2017				MONITORING REQUIREMENTS	
		MONTHLY AVERAGE	WEEKLY AVERAGE	MIN	MAX	FREQUENCY	SAMPLE TYPE
Flow	NA	NL	NA	NA	NL	1/Day	(c) Estimate
pH (SU)	3	NA	NA	6.0 S.U.	9.0 S.U.	1/Week	Grab
BOD ₅	2,4	30 mg/l 3.4 kg/d	45 mg/l 5.1 kg/d	NA	NA	1/3 Months	Grab
Total Suspended Solids	1	30 mg/l 3.4 kg/d	45 mg/l 5.1 kg/d	NA	NA	1/3 Months	Grab
Dissolved Oxygen	3,5	NA	NA	6.1 mg/l	NA	1/Week	Grab
(d) Total Residual Chlorine	3,4	0.011 mg/l	0.013 mg/l	NA	NA	1/Day	Grab

- a.
 1. Federal Effluent guidelines
 2. Best Engineering Judgment:
 3. Water Quality standard
 4. Other (e.g. wasteload allocation model)
 5. Best Professional Judgment
- b. Express limits in units of concentration (mg/l) and/or mass (kg/d).
- c. Estimated average daily flowrate shall be based on the most accurate method or device available such as: weir, potable water meter, pump rates, etc.
- d. ADDITIONAL INSTRUCTIONS AND MONITORING REQUIREMENTS FOR TRC
See Items 1-5 below.
 1. The permittee shall monitor TRC at the outlet of the chlorine contact tank, *once per day by grab sample.*
 2. No more than (3) samples of all samples taken at the outlet of the chlorine contact tank shall be less than 1.0 mg/l for any one calendar month [DMR code # 157].

3. No TRC sample collected at the outlet of the chlorine contact tank shall be less than 0.60 mg/l [DMR code # 213].
4. If dechlorination facilities exist the samples above shall be collected prior to dechlorination.
5. If chlorine is not used, bacteria shall be limited and monitored by the permittee as specified below:

	Discharge	Limitations	Monitoring	Requirements
	Monthly Avg.	Weekly Avg.	Frequency	Sample Type
E.coli (N/100ml)	126*	NA	1/Week**	Grab

* Geometric Mean; ** Between 10:00 a.m. and 4:00 p.m.

17. Basis for Sludge Use & Disposal:
VPDES Permit Regulation, 9VAC25-31-100 P; 220 B 2; and 420 through 720, and 40 CFR Part 503 require all treatment works treating domestic sewage to submit information on sludge use and disposal practices and to meet specified standards for sludge use and disposal.
18. Antibacksliding Statement:
Compliance with antibacksliding provisions of the Permit Regulation (9VAC25-31-220.1) have been achieved since no less stringent limitations are contained in this permit.
19. Compliance Schedules: No schedules of compliance are included in this permit.
20. Special Conditions:

PART I.B. Additional TRC Limitations and Monitoring Requirements:

Rationale: Required by Sewage Collection and Treatment Regulations, 9VAC25-790. Also, 40 CFR 122.41(e) requires the permittee, at all times, to properly operate and maintain all facilities and systems of treatment in order to comply with the permit. This ensures proper operation of chlorination equipment to maintain adequate disinfection.

Part I. C. Compliance Reporting Under part I. A.:

Rationale: Authorized by VPDES Permit Regulation, 9VAC25-31-190 J 4 and 220 I. This condition is necessary when pollutants are monitored by the permittee and a maximum level of quantification and/or a specific analytical method is required in order to assess compliance with a permit limit or to compare effluent quality with a numeric criterion.

The condition also establishes protocols for calculation of reported values.

Part I. D. Other Requirements and Special Conditions:

- a. Treatment Plant Flows - 95% Capacity Reopener:
Rationale: Required by VPDES Permit Regulation, 9VAC25-31-200 B 4 for all POTW and PVOTW permits. (Part I.D.1)
- b. Indirect Dischargers:
Rationale: Required by VPDES Permit Regulation, 9VAC25-31-200 B 1 and B 2 for POTWs and PVOTWs that receive waste from someone other than the owner of the treatment works. (Part I.D.2)
- c. O&M Manual Requirement:
Required by Code of Virginia § 62.1-44.19; Sewage Collection and Treatment Regulations, 9VAC25-790; VPDES Permit Regulation, 9VAC25-31-190 E. (Part I.D.3)
- d. Reliability Class:
Rationale: Required by Sewage Collection and Treatment Regulations, 9VAC25-790 for all municipal facilities. (Part I.D.4)
- e. CTC, CTO Requirement:
Rationale: Required by Code of Virginia § 62.1-44.19; Sewage Collection and Treatment Regulations, 9VAC25-790. (Part I.D.5)
- f. Treatment Works Closure Plan:
Rationale: State Water Control Law § 62.1-44.19. This condition is used to notify the owner of the need for a closure plan where a treatment works is being replaced or is expected to close. (Part I.D.6)
- g. Sludge Use and Disposal:
Rationale: VPDES Permit Regulation, 9VAC25-31-100 P; 220 B 2; and 420 through 720, and 40 CFR Part 503 require all treatment works treating domestic sewage to submit information on sludge use and disposal practices and to meet specified standards for sludge use and disposal. (Part I.D.7)
- h. Sludge Reopener:
Rationale: Required by VPDES Permit Regulation, 9VAC25-31-220 C for all permits issued to treatment works treating domestic sewage. (Part I.D.8)
- i. Public Sewerage Service:
Rationale: DEQ strategy to minimize individual discharges and promote regionalization of wastewater treatment. The permit shall be terminated when public sewerage service is made available. (Part I.D.9)

- j. Total Maximum Daily Load (TMDL):
Rationale: Section 303(d) of the Clean Water Act requires that total maximum daily loads (TMDLs) be developed for streams listed as impaired. This special condition is to allow the permit to be reopened if necessary to bring it into compliance with any applicable TMDL approved for the receiving stream. The re-opener recognizes that, according to section 402(o)(1) of the Clean Water Act, limits and/or conditions may be either more or less stringent than those contained in this permit. Specifically, they can be relaxed if they are the result of a TMDL, basin plan, or other wasteload allocation prepared under section 303 of the Act. (Part I.D.10)
- k. Effluent Monitoring Frequency:
Rationale: Permittees are granted a reduction in monitoring frequency based on a history of permit compliance. To remain eligible for the reduction, the permittee should not have violations related to the effluent limits for which reduced frequencies were granted. If permittees fail to maintain the previous level of performance, the baseline monitoring frequencies should be reinstated for those parameters that were previously granted a monitoring frequency reduction. (Part I.D.11)
- l. Part II, Conditions Applicable to All Permits:
Rationale: VPDES Permit Regulation, 9VAC25-31-190 requires all VPDES permits to contain or specifically cite the conditions listed. (Part II)

21. Changes to Permit:

A Total Maximum Daily Load re-opener has been added as a special condition should it become necessary to modify the permit during the development of TMDL's on the Unnamed Tributary to Bad Branch.

All special conditions (95% Flow, Indirect Dischargers, O & M Manual, Reliability Classification, CTC, CTO, Closure Plan, Sludge Use and Disposal, Sludge Reopener and TMDL) are in accordance with the guidance provided in the December 2010 permit manual that is updated on a continual basis. Part II, Conditions applicable to all VPDES permits is in accordance with 9VAC25-31-10 et seq., amended June 6, 2006, effective September 6, 2006, updated August 25, 2011. Parts I, II. and III of the revised Virginia Draft Permit Submission Checklist is included as an addendum to this Fact Sheet. (See Attachment No. 6)

22. Variances/Alternate Limits or Conditions:

In a letter dated October 31, 2006 waivers were requested from the collection of composite samples and fecal coliform testing on EPA Form 2A, Part A.12. The approvals of these waivers are continued for this permit application and remain on file at DEQ.

23. Regulation of Users: 9VAC25-31-280 B 9:
There are no industrial users contributing to the treatment works.

24. Public Notice Information required by 9VAC25-31-280 B:

All pertinent information is on file and may be inspected and copied by contacting *Steve E. Artrip* at: Department of Environmental Quality (DEQ), Southwest Regional Office, 355 Deadmore Street, P.O. Box 1688, Abingdon, Virginia 24212. Telephone: 276-676-4808, E-mail: steve.artrip@deq.virginia.gov.

Persons may comment in writing or by email to the DEQ on the proposed permit action, and may request a public hearing, during the comment period. Comments shall include the name, address, and telephone number of the writer and of all persons represented by the commenter/requester, and shall contain a complete, concise statement of the factual basis for comments. Only those comments received within this period will be considered. The DEQ may decide to hold a public hearing, including another comment period, if public response is significant and there are substantial, disputed issues relevant to the permit. Requests for public hearings shall state 1) the reason why a hearing is requested; 2) a brief, informal statement regarding the nature and extent of the interest of the requester or of those represented by the requester, including how and to what extent such interest would be directly and adversely affected by the permit; and 3) specific references, where possible, to terms and conditions of the permit with suggested revisions. Following the comment period, the Board will make a determination regarding the proposed permit action. This determination will become effective, unless the DEQ grants a public hearing. Due notice of any public hearing will be given. The public may review the draft permit and application at the DEQ the Southwest Regional Office by appointment.

25. Additional Comments:

a. Previous Board Action:
None.

b. Staff Comments:
Threatened and Endangered Species Coordination with DCR is required per email from Ellenore M. Daub, Office of Water Permit and Compliance Assistance, March 07, 2011. The information necessary was submitted to DCR on January 26, 2012.

c. Additional Comments:
None.

d. Public Comment:

26. 303(d) Listed Segments (TMDL):

This facility discharges directly to an Unnamed Tributary to Bad Branch of Guest River. Guest River is listed as impaired on the current 2010 303 (d) list for benthic impairment due to sedimentation and for bacteria/E. Coli. A TMDL for aquatic life use impairment was prepared by DEQ and is entitled "Guest River Total Maximum Daily Load Report TMDL Study for Aquatic Life Use Impairment" and is dated September 2003, revised December 1, 2003. The TMDL was approved by EPA on 11/13/2003 and by the SWCB on 06/27/2007. The TMDL contains a wastelaod allocation for this discharge of 1.4 tons/year total suspended solids, based on a maximum daily flow of 30,000 gallons per day and TSS concentrations of 30 mg/l monthly average and 45 mg/l weekly average. This VPDES permit has limits of 30 mg/l monthly average and 45 mg/l weekly average for total suspended solids that are in compliance with the TMDL. Discharge Monitoring data indicate compliance with these limitations for Total Suspended Solids during the term of the permit.

Permit No.	Receiving Stream	River Mile Location at Bad Branch	Maximum Flow Gallon Per Day	TSS Concentration Weekly Avg. (mg/l)	TSS Concentration Monthly Avg. (mg/l)	TSS Permitted Load (Tons/Year)
VA0023477	Bad Branch UT	6BBAS001.08	30,000	45	30	1.4

A TMDL which addresses bacterial impairment in the Guest River and tributaries is scheduled to be developed within the next 5 years.

Attachment No. 1

Drought Flow Frequencies

Wise Correctional Unit 18

Bad Branch above UT

MEMORANDUM

DEPARTMENT OF ENVIRONMENTAL QUALITY - WATER DIVISION

Water Quality Assessments and Planning

629 E. Main Street

P.O. Box 10009

Richmond, Virginia 23240

RECEIVED

DEC 17 1996

DEQ-SWRO

SUBJECT: Flow Frequency Determination
Wise Correctional Unit #18 STP - VA#0023477

TO: Steve Artrip, SWRO

FROM: Paul Herman, WQAP *Paul*

DATE: December 13, 1996

COPIES: Ron Gregory, Charles Martin, File

The Wise Correctional Unit #18 STP discharges to an unnamed tributary of the Bad Branch near Coeburn, VA. Stream flow frequencies are required at this site for use by the permit writer in developing effluent limitations for the VPDES permit.

At the discharge point, the receiving stream is depicted as a dry ravine on the USGS Coeburn Quadrangle topographic map. The flow frequencies for dry ravines are 0.0 cfs for the 1Q10, 7Q10, 30Q5, high flow 1Q10, high flow 7Q10, and harmonic mean. Flow frequencies have been determined for the Bad Branch at a point above the unnamed tributary and for the Guest River at a point above Bad Branch.

The USGS operated a continuous record gage on the Guest River at Coeburn, VA (#03524500) from 1949 to 1959 and from 1978 to 1981. The gage was located at the Route 72 bridge just south of Coeburn, VA. The flow frequencies for the gage and the two points identified above are presented below. The values at these points were determined by drainage area proportions and do not address any withdrawals, discharges, or springs lying upstream.

Guest River at Coeburn, VA (#03524500):

Drainage Area = 87.3 mi ²	
1Q10 = 1.8 cfs	High Flow 1Q10 = 7.2 cfs
7Q10 = 2.1 cfs	High Flow 7Q10 = 8.3 cfs
30Q5 = 4.1 cfs	HM = 21 cfs

Bad Branch above unnamed tributary:

Drainage Area = 0.67 mi ²	
1Q10 = 0.014 cfs	High Flow 1Q10 = 0.055 cfs
7Q10 = 0.016 cfs	High Flow 7Q10 = 0.064 cfs
30Q5 = 0.031 cfs	HM = 0.161 cfs

Attachment No. 1
Drought Flow Frequencies
Wise Correctional Unit 18
Page 2

Guest River above Bad Branch:

Drainage Area = 86 mi ²	
1Q10 = 1.77 cfs	High Flow 1Q10 = 7.09 cfs
7Q10 = 2.07 cfs	High Flow 7Q10 = 8.18 cfs
30Q5 = 4.04 cfs	HM = 20.69 cfs

The high flow months are December through May. If you have any questions concerning this analysis, please let me know.

To: Steve E. Artrip@ABC@DEQ
From: Paul E. Herman@WQA
Cc:
Subject: Wise Correctional Unit #18 - VA0023477
Attachment:
Date: 01/09/2002 10:46 AM

Steve,

As there have been no changes to this facility's outfall location, please continue to use the flow frequencies presented for the UT to Bad Branch as outlined in my December 13, 1996, memo to you. That memo provides flow frequencies for the discharge point, the Bad Branch above the confluence with the discharge receiving stream (UT), and the Guest River above Bad Branch.

Your flow frequency request form dated 7/6/01 for this facility **incorrectly** listed the 7Q10 flow for the receiving stream as 0.010 mgd. At the discharge point, the 7Q10 is 0.0 mgd, as the receiving stream is a dry ravine. The 7Q10 of 0.010 mgd would apply to the perennial Bad Branch at the point just above the confluence with the dry ravine.

If you have any questions, please let me know.

Paul E. Herman, P.E.
Surface Water Investigations
Dept. of Environmental Quality
(804) 698-4464

Attachment No. 1
Drought Flow Frequencies
Wise Correctional Unit 18
Page 3

Attachment No. 2



0 0.3 0.6 0.9 1.2 1.5 km
0 0.2 0.4 0.6 0.8 1 mi

36° 55' 06"N, 82° 27' 49"W (NAD83/WGS84)

USGS Coeburn (VA) Quadrangle

Projection is UTM Zone 17 NAD83 Datum

M_{sk}
M=-6.269
G=-0.879

Calculation of Ammonia Nitrogen (NH₃-N) Limits

Attachment No. 3 1997 ANALYSIS

Facility Name: Virginia Department of Corrections-Wise Correctional Unit No. 18 STP

VPDES Permit No: VA0023477

BACKGROUND:

When this permit was reissued (June 1992), the permittee was required to monitor pH and temperature in the receiving stream, upstream of the STP discharge. These data were collected from the Guest River which is ultimately the receiving stream and will be used to establish the ammonia nitrogen instream water quality standards. The permittee was also required to monitor ammonia nitrogen concentrations from the effluent. These effluent data will be statistically evaluated to determine the appropriate ammonia nitrogen limitation for the discharge.

STANDARDS:

NH₃-N limits must be the more restrictive of either the acute or chronic values, which are derived from the calculation of the formulas in the Water Quality Standards. See pages 7-10 of this attachment for details of the calculations. Human Health standards are not applicable for ammonia.

90th percentile pH and temperature values were established from data collected by the permittee on the Guest River from September 1992 through October 1996. A summary of these data are listed below. For details of these data see page 6.

Summer pH = 7.5 Summer Temperature = 21°C

Winter pH = 7.2 Winter Temperature = 14°C

The calculated ammonia nitrogen water quality standards (WQS) are:

Acute Dry Season Std.	Acute Wet Season Std.	Chronic Dry Season Std.	Chronic Wet Season Std.
11.97 mg/l	17.04 mg/l	1.92 mg/l	2.12 mg/l

Attachment No. 3

page 2

Calculation of Ammonia Nitrogen ($\text{NH}_3\text{-N}$) Limits

MIXING ANALYSIS @ Bad Branch

Effluent flow = 0.030 MGD

Stream 7Q10 flow = 0.010 MGD

Stream 1Q10 flow = 0.009 MGD

Width = 2 ft

Slope (ft/ft) = 0.080 -

Bottom scale = 4

Channel has normal irregularities

CHRONIC RESULTS

7Q10 depth = 0.07 ft

7Q10 velocity = 0.47 ft/sec = 7.7 mi / day

Mixing length @ 7Q10 = 28 ft = Residence time = 0.001 days

****COMPLETE MIX MAY BE USED FOR THE CHRONIC WLA****

Percent of 7Q10 to be used for WLAc = 100%

ACUTE RESULTS

1Q10 depth = 0.06 ft

1Q10 velocity = 0.47 ft/sec = 7.6 mi / day

Mixing length @ 1Q10 = 28 ft = Residence time = 0.017 hours

****COMPLETE MIX MAY BE USED FOR THE ACUTE WLA****

Percent of 1Q10 to be used for WLAa = 100%

Calculation of Ammonia Nitrogen (NH₃-N) Limits (continued)

WASTELOAD ALLOCATIONS:

Assuming a background NH₃-N concentration of 0, the wasteload allocations are calculated using the following mass balance equations.

$$WLA_{\text{acute summer dry}} = CO_s\text{-Acute } (Q_{s-1} + Q_e) / Q_e$$

$$WLA_{\text{acute summer dry}} = 11.97 (0.009 + 0.030) / 0.030$$

$$WLA_{\text{acute summer}} = \underline{15.6 \text{ mg/l}}$$

$$WLA_{\text{acute winter wet}} = Co_w\text{-Acute } (Q_{s-1} + Q_e) / Q_e$$

$$WLA_{\text{acute winter wet}} = 17.04 (0.036 + 0.030) / 0.030$$

$$WLA_{\text{acute winter}} = \underline{37.5 \text{ mg/l}}$$

$$WLA_{\text{chronic summer dry}} = Co_s\text{-Chronic } (Q_{s-7} + Q_e) / Q_e$$

$$WLA_{\text{chronic summer dry}} = 1.92 (0.010 + 0.030) / 0.030$$

$$WLA_{\text{chronic summer}} = \underline{2.6 \text{ mg/l}}$$

$$WLA_{\text{chronic winter wet}} = Co_w\text{-Chronic } (Q_{s-7} + Q_e) / Q_e$$

$$WLA_{\text{chronic winter wet}} = 2.12 (0.041 + 0.030) / 0.030$$

$$WLA_{\text{chronic winter}} = \underline{5.0 \text{ mg/l}}$$

PERMIT LIMITS

The WLA's (chronic and acute) and effluent data collected by the permittee from October 1991 through October 1996 were entered into the QWPS's WLA computer program. NO PERMIT LIMIT IS REQUIRED for the summer or winter tier. The output statistics may be found on page 4 and 5 of this attachment.

ANTIBACKSLIDING

It has been demonstrated than no permit limit for ammonia nitrogen is necessary to maintain the instream concentrations of ammonia well below the requirements of the water quality standards. No permit limitation for ammonia nitrogen has ever been in effect for this permit. Therefore, antibacksliding is not an issue.

Attachment No. 3

page 4

Calculation of Ammonia Nitrogen ($\text{NH}_3\text{-N}$) Limits (continued)

Analysis of the Virginia Department of Corrections-Wise Correctional Unit No. 18 STP (Summer Tier June-November) effluent data for Ammonia

The statistics for Ammonia are:

Number of values	=	29
Quantification level	=	.2
Number < quantification	=	6
Expected value	=	.6622687
Variance	=	.3830794
C.V.	=	.9345664
97th percentile	=	2.125885
Statistics used	=	delta lognormal

The WLAs for Ammonia are:

Acute WLA	=	15.6
Chronic WLA	=	2.6
Human Health WLA	=	NA

The limits are based on chronic toxicity and 1 samples/month.
NO LIMIT NEEDED FOR Ammonia

DATA

1.0
1.0
1.0
1.1
0.6
<0.2
0.6
0.4
1.0
3.0
1.0
<0.2
0.22
0.3
0.5
<0.6
<0.2
0.3
0.3
0.6
0.2
0.5
0.5
<0.5
0.5
<0.2
0.3
3.0
0.5

Attachment No. 3

page 5

Calculation of Ammonia Nitrogen ($\text{NH}_3\text{-N}$) Limits (continued)

Analysis of the Virginia Department of Corrections-Wise Correctional Unit No. 18 STP (Winter Tier December-May) effluent data for Ammonia

The statistics for Ammonia are:

Number of values	=	30
Quantification level	=	.2
Number < quantification	=	13
Expected value	=	.6684862
Variance	=	.7374892
C.V.	=	1.284652
97th percentile	=	2.822751
Statistics used	=	delta lognormal

The WLAs for Ammonia are:

Acute WLA	=	37.5
Chronic WLA	=	5.0
Human Health WLA	=	NA

The limits are based on chronic toxicity and 1 samples/month.
NO LIMIT NEEDED FOR Ammonia

DATA

1.0
0.9
1.4
0.34
1.4
<0.2
0.9
1.4
<0.2
<0.2
2.0
<0.2
<0.2
1.3
0.5
0.28
<0.2
1.0
<0.5
<0.5
<0.5
<0.5
<0.5
<0.2
0.2
0.2
<0.2
1.5
0.2
1.6

Attachment No. 3
page 6

Guest River above Bad Branch
Data collected by Permittee
1992-1996 (Dry Season June-Nov.)

<u>Rank</u>	<u>pH S.U.</u>	<u>Temperature °C</u>	
25	7.80	23.00	
24	7.60	23.00	
23	7.50	21.00	90th Percentile
22	7.50	21.00	
21	7.50	21.00	
20	7.40	20.00	
19	7.40	20.00	
18	7.20	19.00	
17	7.20	18.00	
16	7.20	18.00	
15	7.20	18.00	
14	7.20	18.00	
13	7.10	18.00	
12	7.10	18.00	
11	7.10	17.00	
10	7.10	17.00	
9	7.10	17.00	
8	7.00	17.00	
7	7.00	16.00	
6	6.90	14.00	
5	6.90	13.00	
4	6.80	12.00	
3	6.80	12.00	
2	6.80	10.00	
1	6.80	8.00	
	22.50	22.50	90th Percentile

Guest River above Bad Branch
Data collected by Permittee
1992-1996 (Wet Season Dec.- May)

<u>Rank</u>	<u>pH S.U.</u>	<u>Temperature °C</u>	
23	7.50	15.00	
22	7.40	15.00	
21	7.20	14.00	90th Percentile
20	7.20	13.00	
19	7.20	13.00	
18	7.20	11.00	
17	7.20	10.00	
16	7.10	10.00	
15	7.10	9.00	
14	7.10	9.00	
13	7.00	9.00	
12	7.00	9.00	
11	6.90	8.00	
10	6.90	8.00	
9	6.90	8.00	
8	6.90	8.00	
7	6.90	8.00	
6	6.90	7.00	
5	6.80	7.00	
4	6.80	7.00	
3	6.80	6.00	
2	6.60	6.00	
1	6.60	6.00	
	20.70	20.70	90th Percentile

FORMULAS USED IN THE CALCULATION OF
ACUTE CRITERIA VALUES FOR AMMONIA IN FRESHWATER

[The one hour average concentration of ammonia
(in mg/L as un-ionized NH₃) calc. as follows].

B.- ACUTE AMMONIA STANDARD FOR WARMWATER HABITATS -
TROUT/ OTHER SENSITIVE COLDWATER SPECIES ABSENT

ENTER STREAM TEMPERATURE 21.00 C

ENTER STREAM pH 7.50 S.U.

FORMULA: ACUTE (un-ionized) AMMONIA CRITERIA= $0.52 / FT / FpH / 2$

ACUTE un-ionized AMMONIA CRITERIA = 0.19

where: 1) FT = Final Temperature = $\frac{0.03(20 - TCAP)}{10}$; TCAP < T < 30 C

TCAP = 25 C since trout, coldwater species
absent

or = $\frac{0.03(20 - T)}{10}$; 0 < T < TCAP

FT = 0.93

2) FpH = Final pH = 1 ; if 8.0 < pH < 9.0

or = $\frac{7.4 - pH}{(1 + 10^{pH - 7.4}) / 1.25}$; if 6.5 < pH < 8.0

FpH = 1.44

3) Fraction of un-ionized Ammonia = $\frac{1}{10^{pKa - pH} + 1}$

pKa = $0.09018 + (2729.92 / (273.2 + \text{Temperature } C))$

pKa = 9.37

Fraction of un-ionized Ammonia = 0.01

4) Total Ammonia Criteria = Calc. Un-ionized Criteria/ Fraction of Un-ionized NH₃

Total Ammonia Criteria = 14.56

5) NH₃-N Criteria Value = 14.56 X .822 = 11.97 mg/L Acute Dry Season Std.

FORMULAS USED IN THE CALCULATION OF
ACUTE CRITERIA VALUES FOR AMMONIA IN FRESHWATER

[The one hour average concentration of ammonia
(in mg/L as un-ionized NH₃) calc. as follows].

B:- ACUTE AMMONIA STANDARD FOR WARMWATER HABITATS -
TROUT/ OTHER SENSITIVE COLDWATER SPECIES ABSENT

ENTER STREAM TEMPERATURE 14.00 C

ENTER STREAM pH 7.20 S.U.

FORMULA: ACUTE (un-ionized) AMMONIA CRITERIA= $0.52 / FT / FpH / 2$

ACUTE un-ionized AMMONIA CRITERIA = 0.08

where: 1) FT = Final Temperature = $\frac{0.03(20 - TCAP)}{10}$; TCAP < T < 30 C

TCAP = 25 C since trout, coldwater species
absent

or = $\frac{0.03(20 - T)}{10}$; $0 < T < TCAP$

FT = 1.51

2) FpH = Final pH = 1 ; if $8.0 < pH < 9.0$

or = $\frac{7.4 - pH}{(1 + 10^{pH - 7.4}) / 1.25}$; if $6.5 < pH < 8.0$

FpH = 2.07

3) Fraction of un-ionized Ammonia = $\frac{10^{pka - pH}}{10^{pka - pH} + 1}$

pka = $0.09018 + (2729.92 / (273.2 + \text{Temperature } C))$

pka = 9.60

Fraction of un-ionized Ammonia = 0.00

4) Total Ammonia Criteria = Calc. Un-ionized Criteria/ Fraction of Un-ionized NH₃

Total Ammonia Criteria = 20.73

5) NH₃-N Criteria Value = $20.73 \times 0.822 = 17.04$ mg/L Acute Wet Season Std.

FORMULAS USED IN THE CALCULATION OF
CHRONIC CRITERIA VALUES FOR AMMONIA IN FRESHWATER

[The 4-DAY average concentration of ammonia
(in mg/L as un-ionized NH₃) calc. as follows].

D.- CHRONIC AMMONIA STANDARD FOR WARMWATER HABITATS -
TROUT/ OTHER SENSITIVE COLDWATER SPECIES ABSENT

ENTER STREAM TEMPERATURE 21.00 C

ENTER STREAM pH 7.50 S.U.

FORMULA: CHRONIC (un-ionized) NH₃ CRITERIA= 0.80/ FT/ FpH/ RATIO

CHRONIC un-ionized AMMONIA CRITERIA= 0.03

where: 1) FT = Final Temperature = $\frac{0.03(20 - \text{TCAP})}{10}$; TCAP < T < 30 C
TCAP = 20 C since trout, coldwater species
absent

or = $\frac{0.03(20 - T)}{10}$; 0 < T < TCAP

FT = 1.00

2) FpH = Final pH = 1 ; if 8.0 < pH < 9.0

or = $\frac{7.4 - \text{pH}}{(1 + 10^{7.4 - \text{pH}})/1.25}$; if 6.5 < pH < 8.0

FpH = 1.44

3) RATIO = 13.5 ; if 7.7 < pH < 9.0

or RATIO = $20.25 \times \frac{10^{7.7 - \text{pH}}}{(1 + 10^{7.4 - \text{pH}})}$; if 6.5 < pH < 7.7

RATIO = 17.89

4) Fraction of un-ionized Ammonia = $\frac{1}{10^{\text{pka} - \text{pH}} + 1}$

pka = 0.09018 + (2729.92/(273.2 + Temperature C))

pka = 9.37

Fraction of un-ionized Ammonia = 0.01

5) Total Ammonia Criteria = Calc. Un-ionized Criteria/ Fraction of Un-ionized NH₃

Total Ammonia Criteria = 2.34

6) NH₃-N Criteria Value = 2.34 X .822 = 1.92 mg/L Chronic Dry Season Std.

FORMULAS USED IN THE CALCULATION OF
CHRONIC CRITERIA VALUES FOR AMMONIA IN FRESHWATER

[The 4-DAY average concentration of ammonia
(in mg/L as un-ionized NH₃) calc. as follows].

D.- CHRONIC AMMONIA STANDARD FOR WARMWATER HABITATS -
TROUT/ OTHER SENSITIVE COLDWATER SPECIES ABSENT

ENTER STREAM TEMPERATURE 14.00 C

ENTER STREAM pH 7.20 S.U.

FORMULA: CHRONIC (un-ionized) NH₃ CRITERIA= 0.80/ FT/ FpH/ RATIO

CHRONIC un-ionized AMMONIA CRITERIA= 0.01

where: 1) FT = Final Temperature = $\frac{0.03(20 - TCAP)}{10}$; TCAP < T < 30 C
TCAP = 20 C since trout, coldwater species
absent

or = $\frac{0.03(20 - T)}{10}$; 0 < T < TCAP

FT = 1.51

2) FpH = Final pH = 1 ; if 8.0 < pH < 9.0

or = $\frac{7.4 - pH}{(1 + 10)^{1/1.25}}$; if 6.5 < pH < 8.0

FpH = 2.07

3) RATIO = 13.5 ; if 7.7 < pH < 9.0

or RATIO = $20.25 \times \frac{(10^{7.7 - pH})}{(1 + 10^{7.4 - pH})}$; if 6.5 < pH < 7.7

RATIO = 24.77

4) Fraction of un-ionized Ammonia = $\frac{1}{(10^{pka - pH}) + 1}$

pka = $0.09018 + (2729.92 / (273.2 + \text{Temperature } C))$

pka = 9.60

Fraction of un-ionized Ammonia = 0.00

5) Total Ammonia Criteria = Calc. Un-ionized Criteria/ Fraction of Un-ionized NH₃

Total Ammonia Criteria = 2.58

6) NH₃-N Criteria Value = 2.58 X .822 = 2.12 mg/L Chronic Wet Season Std.

Attachment No. 4
Dissolved Oxygen Model

1997 ANALYSIS

The wasteload allocation model for BOD₅ (and TKN) has been updated using new drought flow frequencies provided by OWPS-WQAP in Memorandum dated December 13, 1996. The Regional staff calculated a drainage area of 0.98 mi², which is slightly higher than the 0.67 mi² calculated by OWPS-WQAP. Therefore, the 7Q10 value was adjusted accordingly.

The model was based on antidegradation considerations for Tier I waters at stream standards. Details of the model may be found on the following pages of this attachment. The Model was calculated by hand because the Regional Modeling package had the following limitations:

1. The Regional Model would not allow a reaeration (k_2) value higher than 20 d⁻¹ to be used, although field observations, the stream slope and modeling experience indicate that a much higher value is appropriate. Therefore, the model was calculated by hand using a k_2 value of 100 d⁻¹.
2. The Regional Model assumed a background BOD for the dry ditch portion of the stream, although there is no background for this portion.

The treatment facility has operated for many years, with no observed or reported water quality problems. The results of the model indicate that the average water quality standard (5.0 mg/l) for dissolved oxygen is being maintained in the receiving stream. The staff feels that the existing secondary limits (for BOD₅) are adequate to protect stream standards.

Wasteload Allocation Model for Dissolved Oxygen

Variables:

K Values

K_1 = BOD Decay Rate = 2.0 d^{-1} (based on Agency Modeling Manual for very shallow, high velocity streams).

K_n = NBOD Decay Rate = 0.75 d^{-1} (based on Agency Modeling Manual for very shallow, high velocity streams).

K_2 = Reaeration Rate = $[0.025 (Dh/l) (24) [1.024^{T-20}]$ (Tsivoglou's Equation accepted by Agency).

Dh = change in elevation in ft. = 300 ft.

l = length in miles = 0.51 mi.

T = Temperature = 21°C (Dry Season, June-November)

K_2 = $[0.025 \frac{(300)}{(0.51)} (24)] [1.024^{21-20}] = 361 \text{ d}^{-1}$

According to the AWARE Modeling Manual, K_2 rates, calculated with Tsivoglou's Equation, having a range of $0.02 - 360 \text{ d}^{-1}$ are applicable. $K_2 = 100 \text{ d}^{-1}$ will be used to allow a margin as a safety.

Velocity

Velocity = $\frac{1.486}{n} (\text{slope})^{1/2} (\text{Hr})^{2/3}$ - Mannings Equation

n = Roughness coeff. = .15 (for large rock)

slope = 0.1136 ft/ft

Hr = Hydraulic Radius = 0.053, (based on rectangular stream, depth = 0.07 ft and width = 0.45 ft.

Velocity = $\frac{1.486}{0.17} (0.1136)^{.5} (0.053)^{.67}$

Velocity = 0.467 ft/sec

The field estimated velocity = 1.5 ft/sec

The average of these two velocities = 0.98 ft/sec

Use $V = 1.0 \text{ ft/sec}$ for model - both segments

Time of Travel

Assuming the D.O. sag point is at the confluence of Bad Branch with Guest River, the time of travel is calculated:

$$\text{time} = \text{total distance (ft)} / \text{velocity}$$

The model uses two stream segments:

- (1) dry ditch portion = 0.23 mi (U.T. to Bad Branch)
- (2) Bad Branch to Guest River = 0.28 mi

$$\begin{aligned} \text{Time, Segment 1} &= (0.23 \text{ mi}) (5280 \text{ ft/mi}) / 1 \text{ ft/sec} = 1214 \text{ sec} \\ \text{Time, Segment 1} &= 1214 \text{ sec} = 0.014 \text{ days} \end{aligned}$$

$$\begin{aligned} \text{Time, Segment 2} &= (0.28 \text{ mi}) (5280 \text{ ft/mi}) / 1 \text{ ft/sec} = 1478 \text{ sec} \\ \text{Time, Segment 2} &= 1478 \text{ sec} = 0.017 \text{ days} \end{aligned}$$

Model

Segment 1 - U.T. to Bad Branch

Dt_1 = oxygen deficit at end of segment 1 - to be determined

$$t_1 = \text{travel time to end of segment 1} = 0.014 \text{ days}$$

$$\begin{aligned} Lo_1 &= CBOD_u = \text{Ultimate CBOD of STP since no mixing occurs in} \\ &\quad \text{Segment 1} = CBOD_5 \times 2.5 \\ Lo_1 &= 25 \text{ mg/l} \times 2.5 = 62.5 \text{ mg/l} \end{aligned}$$

$$\begin{aligned} No_1 &= NBOD_u = (TKN - 3.0 \text{ mg/l}) (4.33), \text{ for secondary treatment,} \\ &\quad \text{TKN assumed to be 20 mg/l} \\ No_1 &= (20 - 3) (4.33) = 17 \times 4.33 = 73.61 \text{ mg/l} \end{aligned}$$

Do_1 = Initial deficit from Background = 0, since no background in dry ditch

$$K_1 = 2.0 \text{ d}^{-1}$$

$$K_n = 0.75 \text{ d}^{-1}$$

$$K_2 = 100 \text{ d}^{-1}$$

$$Dt_1 = DO_1 e^{-k_2 t_1} + \frac{Lo_1 K_1}{K_2 - K_1} [e^{-k_1 t_1} - e^{-k_2 t_1}] + \frac{No_1 K_n}{K_2 - K_n} [e^{-k_n t_1} - e^{-k_2 t_1}]$$

$$Dt_1 = 0 + \frac{(62.5)(2.0)}{(100 - 2)} [e^{-2(.014)} - e^{-100(.014)}] + \frac{(73.61)(0.75)}{(100 - 0.75)} [e^{-.75(.014)} - e^{-100(.014)}]$$

$$Dt_1 = (1.276) [e^{-.028} - e^{-1.4}] + 0.556 [e^{-0.0105} - e^{-1.4}]$$

$$Dt_1 = 1.276 [0.725] + 0.556 [0.743]$$

$$Dt_1 = 0.925 + 0.413 = 1.338$$

Segment 2 - Bad Branch

Dt_2 = Oxygen deficit at end of Segment 2

t_2 = Travel time to end of segment 2 = 0.017 days

Lo_2 = Remaining CBODu at end of Segment 1

$$Lo_2 = Lo_1 e^{-k_1 t_1} = 62.5 e^{-2(.014)} = 60.75 \text{ mg/l}$$

No_2 = Remaining NBODu at end of Segment 1

$$No_2 = No_1 e^{-k_n t_1} = 73.61 e^{-0.75(.014)} = 72.8 \text{ mg/l}$$

Do_2 = Initial D.O. deficit at beginning of Segment 2

Do_2 = (Background 90% sat D.O. of Bad Br.) - D.O. Mix at conf. of Bad Br. and Dry Ditch

Effluent D.O. at end of Dry Ditch = (Initial D.O.) - (Dt_1)

Effluent D.O. at end of Dry Ditch = (6.1) - (1.338)

Effluent D.O. at end of Dry Ditch = 4.762 mg/l

D.O._{mix} at confluence with Bad Branch =

D.O._{mix} = (90% Sat.D.O.)x(7Q10)+(Eff.D.O.@end of Seg 1)x(Eff. Flow)

$$D.O._{mix} = \frac{7.432(.015) + 4.762(0.03)}{0.015 + 0.03}$$

$$D.O._{mix} = \frac{.111 + 0.142}{.045} = 5.62 \text{ mg/l}$$

Therefore, $Do_2 = 7.432 - 5.62 = 1.812 \text{ mg/l}$

$$Dt_2 = Do_2 e^{-K_2 t_2} + \frac{Lo_2 K_1}{K_2 - K_1} [e^{-K_1 t_2} - e^{-K_2 t_2}] + \frac{No_2 K_n}{K_2 - K_n} + [e^{-K_n t_2} - e^{-K_2 t_2}]$$

$$Dt_2 = (1.812) [e^{-100(.017)}] + \frac{(60.75)(2)}{100-2} [e^{-2(.017)} - e^{-100(.017)}] +$$

$$\frac{72.8(.75)}{100-.75} [e^{-.75(.017)} - e^{-100(.017)}]$$

$$Dt_2 = 1.812 (.1827) + 1.24 (.784) + 0.55(0.99 + 0.18)$$

$$Dt_2 = .33 + 0.97 + .64 = 1.94 \text{ mg/l}$$

Therefore, the D.O. of Stream at end of Model (before confluence with Guest River = $Dt_1 - Dt_2 = 7.4321 - 1.94 = 5.49 \text{ mg/l}$

Location of Model
Wise Correctional Unit # 18
VA0023477

Chlorine

Facility Name: Wise Correction Unit No. 18 Sewage Treatment Plant
VPDES Permit No: VA0023477

BACKGROUND:

In order to bring chlorine into consistency with the standards for all other toxic materials, the old standard was revoked and chlorine was included in 9 VAC 24-260-140.B., which became effective on 12/10/97.

STANDARDS:

Acute Standard = 19 $\mu\text{g/l}$
Chronic Standard = 11 $\mu\text{g/l}$

MIXING ZONE ANALYSIS:

MIXING ANALYSIS FOR Wise Correctional Unit No. 18 STP

Effluent flow = 0.030 MGD
Stream 7Q10 flow = 0.010 MGD
Stream 1Q10 flow = 0.009 MGD
Width = 2ft
Slope (ft/ft) = 0.080
Bottom scale = 4
Channel scale = 1

Mixing Zone Predictions @ 7Q10

Depth = 0.0657 ft
Length = 27.86 ft
Velocity = 0.4704 ft/sec
Residence Time = 0.0007 days

Recommendation: A complete mix assumption is appropriate for this situation and the entire 7Q10 may be used.

Mixing Zone Predictions @ 1Q10

Depth = 0.0648 ft
Length = 28.15 ft
Velocity = 0.4657 ft/sec
Residence Time = 0.0168 hours

Recommendation: A complete mix assumption is appropriate for this situation and the entire 1Q10 may be used.

WASTELOAD ALLOCATIONS:

The Mixing Zone Analysis (above) indicates that it is appropriate to use 100% of the Acute and Chronic drought flow frequencies in determining the wasteload allocation for chlorine. Assuming a background chlorine concentration of 0 mg/l, the wasteload allocations are calculated below.

$$WLA_{acute} = CO_s\text{-Acute} (Q_{s-1} + Q_e) - Q_{s-1} (\text{background}) / Q_e$$

$$WLA_{acute} = 19 (0.009 + 0.030) - 0.009 (0) / 0.030$$

$$WLA_{acute} = \underline{24.7 \text{ } \mu\text{g/l or } 0.025 \text{ mg/l}}$$

$$WLA_{chronic} = CO_s\text{-Chronic} (Q_{s-7} + Q_e) - Q_{s-7} (\text{background}) / Q_e$$

$$WLA_{chronic} = 11 (0.010 + 0.030) - 0.010 (0) / 0.030$$

$$WLA_{chronic} = \underline{14.7 \text{ } \mu\text{g/l or } 0.015 \text{ mg/l}}$$

Where:

$CO_s\text{-Acute}$	= 19	$\mu\text{g/l}$ (Acute Std.)
$CO_s\text{-Chronic}$	= 11	$\mu\text{g/l}$ (Chronic Std.)
Q_{s-1}	= 0.009	MGD (1Q10 flow)
Q_{s-7}	= 0.010	MGD (7Q10 flow)
Q_e	= 0.030	MGD (Effluent flow)

PERMIT LIMITS:

The acute wasteload allocation and a single datum value of 5.0 mg/l were entered into the current version (2.0.3) of the WLA program. Previously, the facility had an instantaneous maximum daily chlorine limit of non-detectable or 0.1 mg/l. Comparing the previous instantaneous maximum concentration of 0.1 mg/l to the newly calculated daily maximum concentration of 0.021 mg/l results in the conclusion that the previous limits are less restrictive than the calculated limits. This eliminates the issue of backsliding as these limits represent the same distribution as the old "standard limits". The results of the WLA program are listed below.

Results using calculated wasteload allocations above:

Facility	Wise Correctional Unit No. 18 Sewage Treatment Plant
Chemical	= Chlorine
Chronic averaging period	= 4
WLAa	= 24.7 $\mu\text{g/l}$
WLAc	= 14.7 $\mu\text{g/l}$
Q.L.	= 0.1
# samples/mo.	= 30
# samples/wk.	= 7

Summary of Statistics:

observations = 1
Expected Value = 5000
Variance = 9000000
C.V. = 0.6
97th percentile daily values = 12167.0
97th percentile 4 day average = 8318.95
97th percentile 30 day average = 6030.26
< Q.L. = 0
Model used = BPJ Assumptions, type 2 data

A limit is needed based on *Chronic Toxicity*

Maximum Daily Limit = 21.4998493255825 $\mu\text{g/l}$ or 0.021 mg/l
Average Weekly limit = 12.8247694688414 $\mu\text{g/l}$ or 0.013 mg/l
Average Monthly limit = 10.6557803457249 $\mu\text{g/l}$ or 0.011 mg/l
The data are: 5000 $\mu\text{g/l}$ or 5 mg/l

Additional TRC Limitations and Monitoring Requirements to ensure proper disinfection of the wastewater.

1. The permittee shall monitor TRC at the outlet of the chlorine contact tank, *once per day by grab sample*.
2. No more than (3) samples of all samples shall be less than 1.0 mg/l for any one calendar month [DMR code # 157].
3. No TRC sample shall be less than 0.60 mg/l [DMR code # 213].
4. If dechlorination facilities exist the samples above shall be collected prior to dechlorination.

**State "Transmittal Checklist" to Assist in Targeting
Municipal and Industrial Individual NPDES Draft Permits for Review**

Part I. State Draft Permit Submission Checklist

In accordance with the MOA established between the Commonwealth of Virginia and the United States Environmental Protection Agency, Region III, the Commonwealth submits the following draft National Pollutant Discharge Elimination System (NPDES) permit for Agency review and concurrence.

Facility Name: Wise Correctional Unit #18 STP

NPDES Permit Number: VA0023477

Permit Writer Name: Steve E. Artrip

Date: 02/3/2012

Major ☐Minor ☒Industrial ☐Municipal ☒

I.A. Draft Permit Package Submittal Includes:

	Yes	No	N/A
1. Permit Application?	X		
2. Complete Draft Permit (for renewal or first time permit– entire permit, including boilerplate information)?	X		
3. Copy of Public Notice?		X	
4. Complete Fact Sheet?	X		
5. A Priority Pollutant Screening to determine parameters of concern?			X
6. A Reasonable Potential analysis showing calculated WQBELs?	X		
7. Dissolved Oxygen calculations?	X		
8. Whole Effluent Toxicity Test summary and analysis?			X
9. Permit Rating Sheet for new or modified industrial facilities?			X

I.B. Permit/Facility Characteristics

	Yes	No	N/A
1. Is this a new, or currently unpermitted facility?		X	
2. Are all permissible outfalls (including combined sewer overflow points, non-process water and storm water) from the facility properly identified and authorized in the permit?	X		
3. Does the fact sheet or permit contain a description of the wastewater treatment process?	X		

I.B. Permit/Facility Characteristics– cont.	Yes	No	N/A
4. Does the review of PCS/DMR data for at least the last 3 years indicate significant non-compliance with the existing permit?		X	
5. Has there been any change in streamflow characteristics since the last permit was developed?		X	
6. Does the permit allow the discharge of new or increased loadings of any pollutants?		X	
7. Does the fact sheet or permit provide a description of the receiving water body(s) to which the facility discharges, including information on low/critical flow conditions and designated/existing uses?	X		
8. Does the facility discharge to a 303(d) listed water?	X		
a. Has a TMDL been developed and approved by EPA for the impaired water?	X		
b. Does the record indicate that the TMDL development is on the State priority list and will most likely be developed within the life of the permit?		X	
c. Does the facility discharge a pollutant of concern identified in the TMDL or 303(d) listed water?	X		
9. Have any limits been removed, or are any limits less stringent, than those in the current permit?		X	
10. Does the permit authorize discharges of storm water?		X	
11. Has the facility substantially enlarged or altered its operation or substantially increased its flow or production?		X	
12. Are there any production-based, technology-based effluent limits in the permit?		X	
13. Do any water quality-based effluent limit calculations differ from the State's standard policies or procedures?		X	
14. Are any WQBELs based on an interpretation of narrative criteria?		X	
15. Does the permit incorporate any variances or other exceptions to the State's standards or regulations?		X	
16. Does the permit contain a compliance schedule for any limit or condition?		X	
17. Is there a potential impact to endangered/threatened species or their habitat by the facility's discharge(s)?		X	
18. Have impacts from the discharge(s) at downstream potable water supplies been evaluated?	X		
19. Is there any indication that there is significant public interest in the permit action proposed for this facility?		X	
20. Have previous permit, application, and fact sheet been examined?	X		

Part II. NPDES Draft Permit Checklist

Region III NPDES Permit Quality Review Checklist – For Non-Municipals
(To be completed and included in the record for all non-POTWs)

II.A. Permit Cover Page/Administration	Yes	No	N/A
1. Does the fact sheet or permit describe the physical location of the facility, including latitude and longitude (not necessarily on permit cover page)?	X		
2. Does the permit contain specific authorization-to-discharge information (from where to where, by whom)?	X		

II.B. Effluent Limits– General Elements	Yes	No	N/A
1. Does the fact sheet describe the basis of final limits in the permit (e.g., that a comparison of technology and water quality-based limits was performed, and the most stringent limit selected)?	X		
2. Does the fact sheet discuss whether “antibacksliding” provisions were met for any limits that are less stringent than those in the previous NPDES permit?	X		

II.C. Technology-Based Effluent Limits (Effluent Guidelines & BPJ)	Yes	No	N/A
1. Is the facility subject to a national effluent limitations guideline (ELG)?		X	
a. If yes, does the record adequately document the categorization process, including an evaluation of whether the facility is a new source or an existing source?			X
b. If no, does the record indicate that a technology-based analysis based on Best Professional Judgement (BPJ) was used for all pollutants of concern discharged at treatable concentrations?			X
2. For all limits developed based on BPJ, does the record indicate that the limits are consistent with the criteria established at 40 CFR 125.3(d)?			X
3. Does the fact sheet adequately document the calculations used to develop both ELG and /or BPJ technology-based effluent limits?	X		
4. For all limits that are based on production or flow, does the record indicate that the calculations are based on a “reasonable measure of ACTUAL production” for the facility (not design)?			X
5. Does the permit contain “tiered” limits that reflect projected increases in production or flow?		X	
a. If yes, does the permit require the facility to notify the permitting authority when alternate levels of production or flow are attained?			X
6. Are technology-based permit limits expressed in appropriate units of measure (e.g., concentration, mass, SU)?	X		

II.C. Technology-Based Effluent Limits (Effluent Guidelines & BPJ)– cont.	Yes	No	N/A
7. Are all technology-based limits expressed in terms of both maximum daily, weekly average, and/or monthly average limits?	X		
8. Are any final limits less stringent than required by applicable effluent limitations guidelines or BPJ?		X	

II.D. Water Quality-Based Effluent Limits	Yes	No	N/A
1. Does the permit include appropriate limitations consistent with 40 CFR 122.44(d) covering State narrative and numeric criteria for water quality?	X		
2. Does the record indicate that any WQBELs were derived from a completed and EPA approved TMDL?		X	
3. Does the fact sheet provide effluent characteristics for each outfall?	X		
4. Does the fact sheet document that a “reasonable potential” evaluation was performed?	X		
a. If yes, does the fact sheet indicate that the “reasonable potential” evaluation was performed in accordance with the State’s approved procedures?	X		
b. Does the fact sheet describe the basis for allowing or disallowing in-stream dilution or a mixing zone?	X		
c. Does the fact sheet present WLA calculation procedures for all pollutants that were found to have “reasonable potential”?	X		
d. Does the fact sheet indicate that the “reasonable potential” and WLA calculations accounted for contributions from upstream sources (i.e., do calculations include ambient/background concentrations where data are available)?	X		
e. Does the permit contain numeric effluent limits for all pollutants for which “reasonable potential” was determined?	X		
5. Are all final WQBELs in the permit consistent with the justification and/or documentation provided in the fact sheet?	X		
6. For all final WQBELs, are BOTH long-term (e.g., average monthly) AND short-term (e.g., maximum daily, weekly average, instantaneous) effluent limits established?	X		
7. Are WQBELs expressed in the permit using appropriate units of measure (e.g., mass, concentration)?	X		
8. Does the fact sheet indicate that an “antidegradation” review was performed in accordance with the State’s approved antidegradation policy?	X		

II.E. Monitoring and Reporting Requirements	Yes	No	N/A
1. Does the permit require at least annual monitoring for all limited parameters?	X		
a. If no, does the fact sheet indicate that the facility applied for and was granted a monitoring waiver, AND, does the permit specifically incorporate this waiver?			X
2. Does the permit identify the physical location where monitoring is to be performed for each outfall?	X		
3. Does the permit require testing for Whole Effluent Toxicity in accordance with the State's standard practices?		X	

II.F. Special Conditions	Yes	No	N/A
1. Does the permit require development and implementation of a Best Management Practices (BMP) plan or site-specific BMPs?		X	
a. If yes, does the permit adequately incorporate and require compliance with the BMPs?			X
2. If the permit contains compliance schedule(s), are they consistent with statutory and regulatory deadlines and requirements?			X
3. Are other special conditions (e.g., ambient sampling, mixing studies, TIE/TRE, BMPs, special studies) consistent with CWA and NPDES regulations?	X		

II.G. Standard Conditions		Yes	No	N/A
1. Does the permit contain all 40 CFR 122.41 standard conditions or the State equivalent (or more stringent) conditions?		X		
List of Standard Conditions – 40 CFR 122.41				
Duty to comply	Property rights	Reporting Requirements		
Duty to reapply	Duty to provide information	Planned change		
Need to halt or reduce activity	Inspections and entry	Anticipated noncompliance		
not a defense	Monitoring and records	Transfers		
Duty to mitigate	Signatory requirement	Monitoring reports		
Proper O & M	Bypass	Compliance schedules		
Permit actions	Upset	24-Hour reporting		
		Other non-compliance		
2. Does the permit contain the additional standard condition (or the State equivalent or more stringent conditions) for existing non-municipal dischargers regarding pollutant notification levels [40 CFR 122.42(a)]?		X		

Part III. Signature Page

Based on a review of the data and other information submitted by the permit applicant, and the draft permit and other administrative records generated by the Department/Division and/or made available to the Department/Division, the information provided on this checklist is accurate and complete, to the best of my knowledge.

Name	<u>Steve E. Artrip</u>
Title	<u>Environmental Engineer Senior</u>
Signature	<u>Steve E. Artrip</u>
Date	<u>02/3/2012</u>